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EXAMINER	
LAROSE, COLIN M	
ART UNIT	**PAPER NUMBER**
2624	

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Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Office Action Summary	Application No. 10/642,358	Applicant(s) BURL ET AL.	
	Examiner Colin M. LaRose	Art Unit 2627	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *16 August 2005 and 16 December 2005*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-7 and 9-53* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *19-26,49,50 and 53* is/are allowed.

6)☒ Claim(s) *27-33,41-48,51 and 52* is/are rejected.

7)☒ Claim(s) *1-7,9-18 and 34-40* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Arguments and Amendments

1. Applicant's amendments and arguments filed 16 August 2005 and 16 December 2005, have been entered and made of record.

Response to Amendments and Arguments

2. Applicant's remarks with respect to newly-amended independent claims 1, 19, 49, and 50 have been considered and are persuasive. Therefore, the previous rejections of these claims has been withdrawn.

Applicant's remarks with respect to newly-amended independent claims 27, 45, 51, and 52 have been considered and are persuasive, but the remarks are now moot in view of the new grounds of rejection established below.

Claim Objections

3. The following sections of 37 CFR §1.75(a) and (d)(1) are the basis of the following objection:

> (a) The specification must conclude with a claim particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention or discovery.
>
> (d)(1) The claim or claims must conform to the invention as set forth in the remainder of the specification and the terms and phrases used in the claims must find clear support or antecedent basis in the description so that the meaning of the terms in the claims may be ascertainable by reference to the description.

4. Claims 1-7 and 9-18 are objected to under 37 CFR §1.75(a) and (d)(1) as failing to particularly point out and distinctly claim the subject matter that the applicant regards as the invention.

Claim 1 recites, "gradient-magnitude smoothed first image pixel data" and "gradient-magnitude smoothed second image pixel data" but does not recite the steps of smoothing the "gradient-magnitude filtered first image pixel data" and smoothing the "gradient-magnitude filtered second image pixel data." These steps are necessary to obtain the "gradient-magnitude smoothed" first and second image pixel data and therefore should be claimed.

Appropriate correction is required.

Claim Rejections - 35 USC § 103

5. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

6. Claims 27, 42, and 51 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 6,462,498 by Filo in view of "A Structure-from-motion Algorithm for Robot Vehicle Guidance" by Wang et al. ("Wang").

Regarding claims 27 and 51, Filo discloses a method (figure 29A) of controlling a behavior of a mobile robot based on a mismatch between an intended motional state and a perceived motional state in a mobile robot, the method comprising:

receiving an indication of the intended motional state, where the motional state is selected from the group including moving and not moving (column 8, lines 58-67+: an indication that the

robot is intended to be moving forward has been received by the robot since it is attempting to move forward);

using data from a sensor that is coupled to the mobile robot to perceive the motional state of the mobile robot, where the perceived motional state of the mobile robot is selected from the group including moving and not moving (column 8, lines 58-67+: a current sensor coupled to the robot is capable of perceiving the motional state of the robot as being stopped (i.e. "stuck" or "entangled"));

comparing the intended motional state to the perceived motional state to detect whether a mismatch exists between the intended motional state and the perceived motional state (column 8, lines 58-67+: the current sensor is operative to detect a mismatch between intended and motional states in the situation where the actual motional state of the robot is "not moving" due to the robot becoming stuck or entangled, and the intended motional state is "moving forward"); and

automatically changing the behavior of the mobile robot at least partly in response to a detected mismatch if:

the intended motional state of the robot indicates that the mobile robot is moving; and

the perceived motional state of the robot indicates that the mobile robot is not moving (column 8, lines 58-67+: the robot automatically reverses direction in response to the mismatch between the perceived and intended motional states).

Filo discloses using data from a current sensor to determine the motional state of the robot rather than visual data from a camera, as claimed.

Wang discloses a method for determining the motion of a mobile robot. In particular, Wang teaches that the actual motional state of a robot can be ascertained by visual data collected

from a camera mounted to the robot (see § 1, p. 30). As shown in figure 1, image data from the camera can be used to determine whether the robot is moving or idle.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Filo by Wang to determine the perceived motional state of the robot using visual data from a camera coupled to the robot, as claimed, since Wang shows that equipping a robot with a camera and using images from the camera to determine the motional state of the robot is a conventional way of ascertaining the actual motional state of the robot. Such a method of determining an actual motional state is considered substantially equivalent to Filo's method for determining when the robot has become stuck since both Wang's and Filo's methods are capable of effectively determining when a robot is not moving notwithstanding the intended motional state of the robot.

Regarding claim 42, Wang discloses the motional state is perceived using only the visual data from the camera (i.e. only the images taken are used for perceiving the motional state).

Regarding claim 43, the combination of Filo and Wang teaches the mobile robot is autonomous, and the method is performed entirely within the mobile robot (i.e. Filo's robot autonomous and requires no remote computing while it is functioning).

7. Claim 44 is rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 6,462,498 by Filo in view of "A Structure-from-motion Algorithm for Robot Vehicle Guidance" by Wang et al. ("Wang"), and further in view of U.S. Patent 6,321,147 by Takeda et al. ("Takeda").

Regarding claim 44, neither Wang nor Filo disclose the steps of transferring, performing, and transferring, as claimed.

Takeda discloses navigating an unmanned vehicle using visual data. In particular, Takeda discloses transferring visual data from the mobile robot to a remote computer (column 7, lines 29-40: visual data is transmitted from the robot to the central monitor station 2);

performing at least part of filtering operations in the remote computer (column 7, lines 29-40: a user in the remote computer station views the visual data and filters the data by discerning movable from immovable obstacles); and

transferring an indication of the perceived motional state of the mobile robot from the remote computer (column 7, lines 41-55: if the detected obstacle does not block the robot's passage, then an instruction indicative of the perceived and commanded motional state is transferred to the robot; for example, the instruction for the robot to run indicates that the perceived motional state is stopped).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Filo and Wang by Takeda to transfer the image data to a remote location for filtering operations, since Takeda shows that it is desirable and conventional to display the image data captured by a robot's camera to a user at a remote location so that a determination can be made about whether the robot can continue to run in the face of an obstacle and so that the user can communicate with the mobile robot (see column 7, lines 15-55).

8. Claim 28 is rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 6,462,498 by Filo in view of "A Structure-from-motion Algorithm for Robot Vehicle Guidance"

by Wang et al. ("Wang"), and further in view of U.S. Patent 5,001,635 by Yasutomi et al. ("Yasutomi").

Regarding claim 28, Filo discloses changing the behavior comprises changing a navigated path by instructing the mobile robot to travel in a direction approximately opposite to that previously requested for at least a distance sufficient to clear an obstruction (i.e. move backwards a sufficient distance to become untangled)

Filo does not appear to disclose instructing the mobile robot to yaw and then resume traveling.

Yasutomi discloses a system for controlling a mobile robot. With regards to figure 8, Yasutomi discloses that when the mobile robot is traveling in a forward direction (y+) and encounters a fixed obstacle such as a wall, the obstacle may be avoided by moving backwards (y-) and instructing the vehicle to yaw so that it continues moving in a different direction away from the obstacle (x+).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Filo and Wang by Yasutomi to instruct the robot to travel backwards and yaw, as claimed, since Yasutomi discloses that these are preferred instructions for avoiding an obstacle that is fixed and cannot be removed by an operator (see column 4, lines 21-51).

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9. Claims 29-33 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 6,462,498 by Filo in view of "A Structure-from-motion Algorithm for Robot Vehicle Guidance" by Wang et al. ("Wang"), and further in view of U.S. Patent 6,809,490 by Jones et al. ("Jones").

Regarding claims 29-33, Filo does not appear to expressly disclose that changing the behavior comprises shutting off motors to conserve battery life, shutting off cleaning brushes, shutting off the vacuum cleaner, and setting an alert.

Jones discloses a mobile robot capable of performing cleaning functions. In particular, Jones discloses that when the robot is intended to be moving but becomes stuck, then escape behaviors such as setting an alert, shutting off motors to conserve battery life, shutting off cleaning brushes, and shutting off the vacuum cleaner are initiated (see column 13, lines 25-63; see also column 5, line 65 through column 6, line 2).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Filo and Wang by Jones to shut off various elements of the robot when the robot becomes stuck or encounters an obstacle, since Jones teaches that, for a mobile robot with cleaning capabilities, it is advantageous to shut off robot components to conserve battery life and prevent floor damage and set an alert for a user when trying to escape from an obstacle or entanglement.

10. Claim 41 is rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 6,462,498 by Filo in view of "A Structure-from-motion Algorithm for Robot Vehicle Guidance" by Wang et al. ("Wang"), and further in view of U.S. Patent 6,362,589 by Inoue et al. ("Inoue").

Regarding claim 41, Filo discloses the intended motional state is moving but does not discloses that changing the behavior comprises: using the indication to determine that the mobile robot has been knocked over; and initiating procedures to restore the mobile robot to an upright position.

Inoue discloses an autonomous robot that includes a routine (figure 9) for determining when the robot has been knocked over and carrying out a procedure to return the robot to an upright position. In particular, Inoue utilizes an indication of intended movement coupled with a reading from an acceleration sensor to determine that the robot has fallen. Then, once the falling has been determined, the robot initiates procedures to get back up. Column 13, lines 63 through column 14, line 22.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Filo and Wang by Inoue to determine that the robot has been knocked over and intialize procedures to stand the robot upright, since Inoue teaches that when a mobile robot is knocked over, it is both desirable and conventional for the robot to autonomously determine that it has been knocked over and attempt to return to the upright state.

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11. Claims 45-48 and 52 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 6,462,498 by Filo in view of "A Structure-from-motion Algorithm for Robot Vehicle Guidance" by Wang et al. ("Wang"), and further in view of U.S. Patent 5,001,635 by Yasutomi et al. ("Yasutomi").

Regarding claims 45 and 52, Filo discloses a method/circuits for controlling the motion of a self-navigating mobile robot, the method comprising:

receiving an indication that the mobile robot is intended to be traveling in a forward direction (column 8, lines 58-67+: an indication that the robot is intended to be moving forward has been received by the robot since it is attempting to move forward);

determining from data collected from a current sensor coupled to the mobile robot that the mobile robot has ceased traveling in a forward direction (column 8, lines 58-67+: a current sensor coupled to the robot is capable of perceiving the motional state of the robot as being stopped (i.e. "stuck" or "entangled"));

discontinuing commands to propel the mobile robot in the forward direction (column 8, lines 58-67+: the robot is instructed to cease moving forward and to move backwards);

commanding the mobile robot to travel in a reverse direction for at least a predetermined distance (column 8, lines 58-67+: the robot is instructed to cease moving forward and to move backwards for a distance until is it no longer entangled);

determining that the mobile robot has traveled in the reverse direction for at least about the predetermined distance and discontinuing commands to propel the mobile robot in the reverse direction (column 8, lines 58-67+: the robot is commanded to move backwards "until" it is no longer entangled – i.e. when the robot has traveled a certain distance that enables it to become untangled, the instructions to move backwards cease);

Filo discloses using data from a current sensor to determine the motional state of the robot rather than visual data from a camera, as claimed.

Wang discloses a method for determining the motion of a mobile robot. In particular, Wang teaches that the actual motional state of a robot can be ascertained by visual data collected from a camera mounted to the robot (see § 1, p. 30). As shown in figure 1, image data from the camera can be used to determine whether the robot is moving or idle.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Filo by Wang to determine the perceived motional state of the robot using visual data

from a camera coupled to the robot, as claimed, since Wang shows that equipping a robot with a camera and using images from the camera to determine the motional state of the robot is a conventional way of ascertaining the actual motional state of the robot. Such a method of determining an actual motional state is considered substantially equivalent to Filo's method for determining when the robot has become stuck since both Wang's and Filo's methods are capable of effectively determining when a robot is not moving notwithstanding the intended motional state of the robot.

Filo also does not appear to expressly disclose instructing the robot to yaw at an angle and commanding the robot to resume forward motion.

Yasutomi discloses a system for navigating a mobile robot. In particular, Yasutomi discloses a decision process for controlling the robot to navigate around obstacles (figure 4). In particular, Yasutomi teaches that when an obstacle is encountered, a method for avoiding the obstacle includes moving backwards (figure 8: "move back once to (y-)") and then continuing movement of the robot in a direction that is perpendicular to the robot ("x+").

In other words, Yasutomi teaches instructing the mobile robot to yaw by at least a first predetermined angle; and commanding the mobile robot to resume forward motion (figure 8, "next (x+)": after the robot is finished moving in the (y-) direction, it is commanded to yaw to the (x+) direction and continue moving forward in that direction).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Filo and Wang by Yasutomi to yaw the robot and continue it to move forward after yawing, since Yasutomi teaches that when an obstacle is detected, it is conventional to avoid the obstacle by moving backwards and then turning the robot so that it can travel in a different

direction away from the obstacle. Such a method of yawing and then resuming motion effectively allows the robot to avoid an obstacle and would have been an obvious modification to Filo and Wang to allow Filo's robot to move in a different direction once it has become untangled by moving backwards.

Regarding claim 46, neither Filo nor Yasutomi discloses moving backward for a predetermined distance but does not disclose the predetermined distance is about 0.2 meters. However, the precise distance to travel backwards is dependent on many factors that are taken into consideration during design and implementation and does not constitute a patentable advance in and of itself.

Regarding claim 47, Yasutomi discloses the predetermined distance corresponds to at least an amount sufficient to permit the mobile robot to distance itself from an interfering object and to yaw freely around an axis without bumping into the interfering object (i.e. the robot moves backward a sufficient distance so that it can yaw and continue moving without bumping the object).

Regarding claim 48, Yasutomi discloses the first predetermined angle is about 90 degrees (i.e. the robot turns from the y+ direction to the x+ direction).

Allowable Subject Matter

12. Claims 34-40 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Regarding claims 34, 35, 37, and 39, the combination of Filo and Wang does not teach using SLAM techniques or that the intended motional state is not moving. Takeda also does not disclose changing the behavior comprises:

disabling mapping functions for recognition of new landmarks until localization is achieved (claim 34);

automatically changing the motional state to moving (claim 35);

disabling mapping functions for recognition of new landmarks until passage of a predetermined amount of time (claim 37); or

disabling mapping functions for recognition of new landmarks until a predetermined number of unmatched landmarks have been observed (claim 39).

Claims 19-26, 49, 50, and 53 are allowed. Applicant's amendments to independent claims 19, 49, and 50 are sufficient overcome the previous rejections thereof, and Applicant's remarks regarding these claims are persuasive.

Claim 1 would be allowable if rewritten to overcome the above claim objection thereto. Applicant's amendment to claim 1 is sufficient to overcome the previous rejections thereof, and Applicant's remarks regarding claim 1 are persuasive.

Conclusion

13. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Colin M. LaRose whose telephone number is (571) 272-7423. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jingge Wu, can be reached on (571) 272-7429. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the TC 2600 Customer Service Office whose telephone number is (571) 272-2600.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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Group Art Unit 2627
20 March 2006

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PRIMARY EXAMINER